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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

# Office Action Summary

**Application No.**

10/529,907

**Applicant(s)**

KURODA ET AL.

**Examiner**

John Ruggles

**Art Unit**

1795

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 18 December 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) 7, 8 and 10 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-6, 9, 11 and 12 is/are rejected.
- 7) ☒ Claim(s) 2-5, 11 and 12 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 April 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date 4/22/05, 6/21/05, 8/1/06
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date: \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Priority***

The instant application is a (371) U.S. National stage entry of PCT/JP04/09283 filed 6/24/04 (published in English), which claims foreign priority to JP 2003-179587 filed 6/24/03 and JP 2004-097983 filed 3/30/04 (each provided in Japanese only without translation). So the foreign priority claims remain unperfected.

Applicants cannot rely upon the foreign priority papers listed above to overcome any rejection in this Office action because English translations of said foreign priority papers have not been made of record in accordance with 37 CFR 1.55. See MPEP § 201.15.

### ***Election/Restrictions***

Applicants' election with traverse of Group 1 (claims 1-6, 9, 11-12) in the reply filed on 12/18/08 is acknowledged. The traversal is on the ground(s) that only nominal additional burden would be required of the Examiner to search Group 2 (claims 7-8, 10) along with the elected Group 1 (claims 1-6, 9, 11-12). However, this is not found persuasive because Groups 1 and 2 were previously shown to have different special technical features (STF) that lack unity and would require separate search strategies. Applicants have failed to rebut this showing for lack of unity between the different inventions of Groups 1 and 2. There would be a serious additional search and examination burden if restriction were not required.

The restriction requirement is still deemed proper and is therefore made FINAL.

Claims 7-8 and 10 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a non-elected invention.

***Specification***

(1) The title of the invention is not sufficiently descriptive. A new title is required that is clearly indicative of the invention to which the elected claims are directed.

The following title is suggested: --NEAR FIELD EXPOSURE METHOD AND APPARATUS, EXPOSURE MASK, AND DEVICE MANUFACTURING METHOD--.

The abstract of the disclosure is objected to because: (2) at lines 8-10 (L8-10), "light is projected to the light blocking member from its second surface side" should be changed to --light is projected to the first surface side of the light blocking member from ~~[[its]]~~ a second surface side of the light blocking member--; (3) at L12, "the openings" should be corrected as --the plurality of openings--, in order to be consistent with L6-7; (4) at L16, "and, on the basis of it" should be changed to --and~~[[,]]~~ on the basis of ~~[[it]]~~ the interference--; and (5) at L18-20, "the exposure is carried out by use of the decreased light intensity portion" must be corrected in accordance with --the exposure is carried out by ~~use of~~ a difference in contrast between the near field light from the plurality of openings and the decreased light intensity portion-- (emphasis added, in order to correspond with the specification at p25/L9-26 in reference to Figure 5, for the reasons discussed below in this Office action). Correction is required. See MPEP § 608.01(b).

The disclosure is also objected to because of the following exemplary informalities: (6) at page 1 line 20 (p1/L20), "haven been" must be corrected as --~~haven been~~ has to be--; (7) at p2/L13 "since such" should be shortened as --~~since~~ such--; and (8) at p3/L13, "superposed one another" should be changed to --~~superposed one~~ superposed, one upon another--.

Appropriate correction is required.

***Claim Objections***

(1) Claim 2 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of previous claim 1 (as interpreted for the reasons(s) stated below in this Office action). As discussed below, the interpretation given to independent claim 1 renders the recitations in claim 2 to be redundant. Claims 3-5 and 11-12 depend either directly or indirectly from claim 2, so claims 3-5 and 11-12 are also objected to due to their dependencies. Applicants are required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Claims 4-5 are objected to because of the following informalities: (2) in claim 4/L3, the dependency should be corrected from “as recited in Claims 1 or 2” (plural) to --as recited in ~~Claims 1 or 2~~ either claim 1 or claim 2-- (singular). Claim 5 depends from claim 4. Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

**Claims 1-6, 9, and 11-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter, which Applicants regard as the invention.**

(A) In claim 1/L5-6, the text “wherein light is projected to the light blocking member from a second surface side of the light blocking member” is unclear. As exemplified in Figure 5, incident light 502 passes through openings 506 and 507 in a light blocking metal film (member) 504 from a second surface 505 of the light blocking member 504 to the first surface 514 of the

light blocking member 504 (see p23/L22 to p24/L18 of the specification). Thus, for the purpose of this Office action and in order to clarify claim 1/L5-6, this text is interpreted as --wherein light is projected to the first surface of the light blocking member from a second surface side of the light blocking member--.

**(B)** Also in claim 1/L7, “the openings” is interpreted as “the plurality of openings”, in order to be consistent with the terminology in claim 1/L2 for the purpose of this Office action.

**(C)** Further in claim 1/L11, the recitation that “the exposure is carried out by use of the decreased light intensity portion” is confusing and unclear. According to the instant specification (at p25/L9-26 in reference to Figure 5), an optical latent image is formed in the resist 517 by a *difference in contrast* between (i) a portion 516 adjacent to the opening at a first surface 514, where the light intensity has a finite value, and (ii) a portion 515 where the light intensity is reduced or decreased (emphasis added). So for the purpose of this Office action, this recitation in claim 1/L11 is interpreted in accordance with the specification to mean that --the exposure is carried out by ~~use of~~ a difference in contrast between the near field light from the plurality of openings and the decreased light intensity portion-- (emphasis added). Claims 2-5 depend from claim 1 and claims 11-12 depend from claim 3.

**(D)** In claim 3/L1-4, the language “the exposure object has a thickness which is smaller than a distance between (i) a position in the decreased light intensity portion where the intensity with respect to a direction normal to the first surface is largest and (ii) an interface between the first surface and the exposure object” is unclear and confusing (e.g., about whether the exposure object thickness refers to **(a)** the thickness of a resist film and a substrate supporting the resist film together or **(b)** the thickness of only a resist film by itself, etc.). However for the purpose of

this Office action, this language in claim 3/L1-4 is interpreted as --the exposure object ~~[[has]]~~ is a resist film having a thickness which ~~that~~ is smaller than a distance between (i) a position in the decreased light intensity portion where the intensity is largest along ~~with respect to~~ a direction normal to the first surface ~~is largest~~ and (ii) an interface between the first surface and the ~~exposure object resist film--~~, in accordance with **(b)** above and the corresponding description of Figures 6A-6B in the specification (at p25/L27 to p27/L12). Claims 11-12 depend from claim 3.

**(E)** In claim 6/L4-5, the text “wherein light is projected to the light blocking *member* from a second surface side of the light blocking *object*” (emphasis added) is unclear and lacks consistency. For the purpose of this Office action in order to clarify this text (in a similar manner to that described above under **(A)** for claim 1/L5-6) and also to improve consistency, this text in claim 6/L4-5 is interpreted as --wherein light is projected to the first surface of the light blocking member from a second surface side of the light blocking ~~*object member--*~~ (emphasis added).

**(F)** Also in claim 6/L6, “the openings” is interpreted as “the plurality of openings”, in order to be consistent with the terminology in claim 6/L2 for the purpose of this Office action.

**(G)** Further in claim 6/L10, the recitation that “the exposure is carried out by use of the decreased light intensity portion” is confusing and unclear. For the purpose of this Office action, this recitation in claim 6/L10 is interpreted in accordance with the specification (at p25/L9-26 in reference to Figure 5, as described above) to mean that --the exposure is carried out by use of a difference in contrast between the near field light from the plurality of openings and the decreased light intensity portion-- (emphasis added).

(H) In claim 9/L4-5, the text “wherein light is projected to the light blocking member from a second surface side of the light blocking member” is interpreted as --wherein light is projected to the first surface of the light blocking member from a second surface side of the light blocking member--, in the same manner as discussed above.

(J) Also in claim 9/L6, “the openings” is interpreted as “the plurality of openings”, in order to be consistent with the terminology in claim 9/L3, in the same manner as discussed above.

(K) Further in claim 9/L10-11, the recitation that “the exposure is carried out by use of the decreased light intensity portion” is interpreted in accordance with the specification (see the passage at p25/L9-26) to mean that --the exposure is carried out by ~~use of~~ a difference in contrast between the near field light from the plurality of openings and the decreased light intensity portion-- (emphasis added), in the same manner as discussed above.

#### ***Claim Rejections - 35 USC § 102 or § 103***

The following is a quotation of the applicable paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:



(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 1-2, 4, 6, and 9 are rejected under 35 U.S.C. 102(b) as being anticipated by Lienau et al. (WO 03/042748, published in English 5/22/03 designating the US and having an international filing date of 11/10/01, 2<sup>nd</sup> IDS 6/21/05 Foreign 1 of 4).**

*Lienau et al.* teach surface plasmon optic devices and radiating surface plasmon sources for photolithography (title). Figures 12a-12b illustrate a surface plasmon exposure apparatus and method to pattern a photoresist layer on a substrate 64 by light passed through periodically arranged apertures or openings 63 in a metal film 62 (light blocking member) on a dielectric support substrate 61 utilized as a photolithographic mask 60 having light incident on the dielectric support 61 toward the metal film 62 (with a second surface against the support substrate 61) so that the resonant condition of the air/metal surface (first surface facing the photoresist) plasmon emits light through the openings 63 in sine wave patterns (p28/L17 to p29/L15) that generate surface plasmon interference characteristics (p12/L14-15). Figure 1 is an illustration of a very similar mask structure 10 having an optical metal film (light blocking member) 11 with a periodic array of nanometer-sized apertures or openings 13 on a dielectric support substrate 12 (p12/L17-25). The periodic openings 13 in the metal film light blocking member 11 produce an air/metal first surface plasmon that is propagated along the first surface of the metal film light blocking member 11 to form an interference pattern (p16/L1-4), which produces an emission pattern dominated by a standing wave of surface plasmon interference with contrast in the resulting near field image (as shown in Figures 2d and 3b, p16/L5-10, as a near field light pattern having periodic alternating increased light intensity portions and decreased

light intensity portions). This near field light pattern is useful for selective exposure to pattern a photoresist (as mentioned above), which is carried out by a difference in contrast between near field light from each opening (in the metal film blocking member) and the adjacent decreased light intensity portion beside each opening (due to surface plasmon interference along the first surface of the metal film blocking member, *instant claims 1-2, 4, 6, 9*).

**Claims 1-2, 4, 6, and 9 are rejected under 35 U.S.C. 102(b) as being anticipated by Ebbesen et al. (US 5,973,316, 2<sup>nd</sup> IDS 6/21/05 US 1 of 1).**

*Ebbesen et al.* teach sub-wavelength aperture arrays with enhanced light transmission (title). A metallic film (light blocking member) has apertures or openings in an array pattern so that when light is incident on the openings, surface plasmons on the metallic film light blocking member are perturbed to result in an enhanced transmission of the light emitted from the individual openings in the light blocking member used for a mask to enhance near field light transmission in photolithography (abstract). Front page Figure 1 shows a thin metal plate or film 10 (light blocking member of any metal, with chromium (Cr), gold (Au), silver (Ag), or aluminum (Al) being preferable) having an array of apertures or openings 12 (diameter is  $d$ , period or pitch between openings is  $P$ ). The thickness ( $t$ ) of the metal light blocking member 10 is preferably given by  $t = (0.05 \text{ to } 10) \cdot d$ . The intensity of incident light is  $I_{\text{INCIDENT}}$  and the intensity of light after traveling through an opening is  $I_{\text{OUTPUT}}$ . The light blocking member 10 in Figure 1 is contemplated to be supported on a substrate (such as glass or quartz, not shown) to form a (near field) mask for photolithography and the openings 12 have a suitable shape (e.g., round, oval, rectangular, etc., c3/L66 to c4/L15). Such a near field mask having a metal film light blocking member (with a periodic array of openings) exhibits distinct zero-order

transmission spectra with well-defined peaks. The maxima occur at wavelengths approximately 10 times the diameter ( $d$ ) of the individual opening 12. Transmissivity is much greater than that expected from conventional theory. The unusual optical properties are due to coupling of incident light with surface plasmons of the periodic openings in the metal light blocking member. This coupling becomes extremely strong at wavelengths of incident light ( $\lambda$ )  $>$  the pitch ( $P$ ). From the peak positions of the transmission spectra as a function of incident angle, dispersion curves are obtained that reflect the structure of a surface plasmon dispersion. It is contemplated that the array of openings perturb properties of the metal light blocking member to result in a well defined surface plasmon energy band structure with gaps. This surface plasmon energy band, along with the contribution of diffraction or interference due to the geometry of the openings (in the metal light blocking member), are believed to be responsible for the enhanced transmissivity through the individual openings (of the metal light blocking member, c4/L16-36). Figure 8A illustrates a photolithography method and apparatus that pass near field light (wavelength is  $\lambda$ ) through very small (sub-wavelength) apertures or openings 81 ( $d < \lambda$ ) in a metal film or plate (light blocking member) on a support substrate 82 as a near field mask to yield lithographic structures having features smaller than  $\lambda/2$  (c6/L35-43). In the light blocking member, the openings 81 can be slots that are  $0.15\mu\text{m}$  (150nm) wide (c6/L63-67). The resulting near field light pattern is useful for selective exposure to pattern a photosensitive material (photoresist) on substrate 83 (c6/L44-47), which is carried out by a difference in contrast between near field light from each opening (in the metal film blocking member) and an adjacent decreased light intensity portion beside each opening (due to surface plasmon interference along a first surface of the metal film blocking member, *instant claims 1-2, 4, 6, 9*).

**Claims 3, 5, and 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Lienau et al. (WO 03/042748) or Ebbesen et al. (US 5,973,316, each on 2<sup>nd</sup> IDS 6/21/05) as discussed above, and Yamaguchi et al. (US 2001/0046719).**

*Lienau et al.* or *Ebbesen et al.* (each as discussed above) do not specifically teach: *[1]* that the (exposure object) resist film thickness is smaller than a distance between (i) a position in the decreased light intensity portion where the intensity is largest along a direction normal to the first surface (of the light blocking member) and (ii) an interface between the first surface and the resist film (*instant claim 3*); *[2]* transferring of an exposure pattern from an exposure layer (such as a resist film) onto an underlying buffer layer on an object substrate (*instant claim 5*); or *[3]* *[a]* additional processing of the exposed resist film for manufacturing a device (*instant claim 11*), *[b]* in combination with transferring an exposure pattern from an exposure layer (such as a resist film) onto an underlying buffer layer on an object substrate for manufacturing the device (*instant claim 12*).

*Yamaguchi et al.* teach a near field exposure method by using a photomask or a mask to form a pattern and an apparatus therefore (title). This method is considered for manufacturing a semiconductor device, such as a semiconductor memory [0004]. The near field mask has a minute aperture or opening that transmits an evanescent light (near field light) and a wider aperture or opening that transmits propagating light. The near field exposure method includes forming a photoresist or a resist with a thickness that is equal to or smaller than a width of the minute opening (of the mask) onto a (object) substrate to be processed [0048], then exposing the resist by incident light through the mask opening. The apparatus includes a light source, a stand for placing or holding the object substrate to be processed with a resist thereon, a stage for

holding the mask, and a unit for controlling the distance between the mask and the resist on the object substrate (abstract). The resist thickness is limited by the width of the smallest opening on the mask (used for near field evanescent light exposure of the resist) or by the smallest pattern width to be formed on the object substrate, in order to minimize lateral extension of the transmitted near field light in the resist layer while still allowing the near field light to extend through the full depth of the resist layer so that the transmitted near field light reaches the object substrate. Therefore, the resist film thickness (**h**) is preferably 100nm or less ( $0 < h \leq 100\text{nm}$ ) [0050]-[0052] (which reads on *instant claim 3 [1f]*). It is also preferable to form a buffer layer between an object substrate and a resist thereon, when an aspect ratio in a developed pattern formed on the object substrate is too small to satisfactorily conduct an additional transfer process such as etching or deposition (on the buffer layer or the underlying object substrate) [0056], [0068]-[0069]. Figures 7A to 7E show a method for forming a pattern by using two buffer layers under the resist layer on the object substrate (e.g., silicon (Si), etc.) [0078]-[0082], whereas the use of a single buffer layer under the resist layer on the object substrate (e.g., silicon (Si), etc.) is illustrated in Figures 8A-8D [0083]-[0088] (*instant claims 5, 11-12 [2], [3][a], [b]*).

It would have been obvious to one of ordinary skill in the art at the time of the invention in the near field exposure methods taught by either *Lienau et al.* or *Ebbesen et al.* to ensure that the (exposure object) resist film thickness is smaller than a distance between (i) a position in the decreased light intensity portion where the intensity is largest along a direction normal to the first surface (of the light blocking member) and (ii) an interface between the first surface and the resist film (such as a resist film thickness (**h**) within the range given by  $0 < h \leq 100\text{nm}$ , limited by the width of the smallest opening on the mask or limited by the smallest pattern width to be

formed on the object substrate), because this would provide a reasonable expectation of success for minimizing lateral extension of the transmitted near field light in the resist layer while still allowing the near field light to extend through the full depth of the resist layer so that the transmitted near field light reaches the object substrate (as taught by *Yamaguchi et al.*) [1]. It would also have been obvious in the near field exposure methods taught by either *Lienau et al.* or *Ebbesen et al.* to include the transfer of an exposure pattern from the exposure layer (such as the resist film) onto an underlying buffer layer on the object substrate [2], and to include additional processing of the exposed resist film for manufacturing a device (such as a semiconductor device) [3] [a] in combination with the transfer of the exposure pattern from the exposure layer (such as the resist film) onto the underlying buffer layer on the object substrate for the process of manufacturing such a semiconductor device [3] [b], because the addition of a buffer layer between the resist film and the underlying object substrate is known to improve the aspect ratio of the resulting pattern formed on the object substrate when conducting the additional transfer process, such as etching or deposition (on the buffer layer or the underlying object substrate, as taught by *Yamaguchi et al.*).

### ***Conclusion and Contact Information***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is (571)272-1390. The examiner can normally be reached on Monday-Wednesday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Mark F. Huff/  
Supervisory Patent Examiner, Art Unit 1795

/John Ruggles/  
Examiner, Art Unit 1795